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USSR Report

MILITARY AFFAIRS

No. 1704

AVIATSIYA I KOSMONAVTIKA

Nos. 4-5, April-May 1982

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Nos. 4-5, APRIL-MAY 1982

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FIGHTER-BOMBERS: FLIGHT TRAINING DISCUSSIONS

Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 4, Apr 82 (signed to press 3 Mar 82) pp 6-7

[Article by Military Pilot-Sniper Col A. Vakulenko: "Instructiveness of Flight Critiques"]

[Text] The flying began in daylight and ended at night. The pilots made bombing runs on the practice range using complex forms of maneuver, and they intercepted airborne targets in daylight, in twilight and at night at various altitudes. Airmen who had experienced interruptions in combat flying for objective reasons managed to restore their lost habits. Lieutenants F. Gareyev, P. Sviridov, A. Andryushchenko and A. Yandin were the first to fly at night aboard third-generation airplanes. Almost all of the young pilots did not do bad in their assignment. The overall score for all forms of aerial skills was high.

It seemed that the critique could be limited to praising the personnel that had participated in the flying and in its support, stating the mission for the following flying day, and no more. But the flight leader felt quite validly that this approach to the results of the work would not be very beneficial, and it would not be instructive. Therefore he devoted persistent attention to analyzing the causes of deviations and the ways of correcting them. In particular he noted that Lieutenant Yandin landed roughly from high level flight. The assistant flight leader had to actively interfere.

The instructor reported that he showed the young pilot how to correctly maintain the descending glide path in all check flights, that he turned his attention to the most complex moments of flying in this leg, and that he explained what signs could provide a prompt indication of a mistake and how it could be competently corrected. However, apparently forgetting the instructor's recommendations, Yandin failed to maintain the required speed and altitude at the control points of the glide path. He noticed the deviation too late, and he was unable to correct for it completely in time.

Lieutenant Yandin's mistake was carefully analyzed in the squadron and the flight. After practicing the necessary actions in the trainer, he was once again subjected to a check flight. Promptly taken steps helped the pilot to eliminate the shortcomings and acquire sound habits of piloting a landing airplane.

And of course, the work of the crews in the previous flight shift is examined in detail in the squadrons and flights, and the flight critiques are carefully organized. But this was not always the case. I have attended lessons in subunits in which the commanders have simply noted the individuals that had performed outstandingly, having received no critical remarks from their senior chief. And yet deeper analysis would invariably reveal shortcomings of the most diverse types. It stands to reason that it would be incorrect to do nothing more than search for sins and dress the airmen down for them. Kind words are an inspiration to everyone and, moreover, they are necessary in the work of a commander. Nevertheless in my opinion an officer conducting a flight critique has no right to neglect the errors, no matter how insignificant they may seem.

I recall a time when Lieutenant A. Konstantinov recovered from a dive at much greater than the permissible G-force. We started analyzing why. It seemed as if the young officer had prepared himself thoroughly before the flight, and moreover, that he had undergone sufficient combat flight training. The flight commander never thought of his errors as large ones. What these errors entailed was that the pilot, being aware of the buffeting phenomenon typical of this aircraft, tended to recover from a dive smoothly, with a G-force much lower than prescribed, manifesting excessive caution. Of course the flight commander instructed the lieutenant to be more decisive and attentive. But constant attentiveness is more than just the pilot's responsibility; it is primarily that of the commanders, since the quality of the aerial skills of their subordinates depends to a decisive degree on them. This truth has been proven by many years of flying experience. The reason behind the young pilot's error was precisely in the insufficient attention devoted to him by commanders.

Analyzing a flight, we should dig down to the roots of each deviation, consider the frequency with which the deviation occurs and mandatorily find the ways of eliminating its causes. This is precisely the approach taken to the violation made by Konstantinov. It was revealed in the end that he had not received enough training in dive bombing. When he had to act more energetically, the pilot did not seem to have enough time to watch his speed and his diving angle, and he felt tense. He did not attach significance to the danger in which he could place himself owing to errors in diving. A great deal of work was done with him. Now Senior Lieutenant Konstantinov is a military pilot 2d class, and he is successfully assimilating the flight program.

Explaining safety measures is an important part of the moral-psychological training of pilots. Controlling their feeling of danger is a delicate matter. Trying to keep their subordinates from taking ill-conceived actions in the air, certain commanders have tried to focus their attention mainly on the dangerous consequences, exaggerating the actual state of affairs. Others, on the contrary, have understated the severity of the danger. In my opinion neither approach is justified. It is important for a pilot to soberly evaluate all situations and make competent decisions. And this is something that must be persistently taught. The essence of every action must be explained patiently and persuasively. The commander--he is also an instructor and an indoctrinator--must carefully study the training progress of his subordinates.

This essentially requires him to work as a real scientist. An example can be found in the work of Captain A. Ryazanov, a flight commander and a top-class air warrior. He possesses the qualities of a real teacher, and he is able to creatively solve the problems of training young airmen.

Once pilots just out of school were assimilating an airplane new to them. Lieutenants A. Gareyev and B. Sviridov progressed in the program with identical success, and it sometimes happened that they made the same mistakes. The errors were made mainly during landing--the most critical and complex phase of flight. The pilots were aware of their mistakes, but they were unable to explain their causes or, moreover, correct them on their own: They did not have enough experience. Captain Ryazanov came to their assistance. Having analyzed the flight's work and having interviewed his subordinates, he came to understand that when they approached the landing strip on a glide path lower than that required, they obscured the landing strip with the nose of their airplane, sharply limiting their forward visibility. How was he to help the young pilots? Ryazanov drew up a plan of trainer lessons together with the squadron commander. The lieutenants carefully practiced the actions of descending on a glide path, they learned to begin level flight right at the correct point, and thus they were able to devote greater attention to landing.

In the very next training session the flight commander was pleased to note that Gareyev and Sviridov were coming to understand the explanations better. Things began to go well. Of course, not only time but also stubborn, persistent labor were required of the instructor and the students before the lieutenants were able to acquire some experience. Now both officers demonstrate good results in solo flights, they are confidently assimilating the combat training program, and they are reinforcing their knowledge with practical work.

Flights and commander training are inseparable links of a single flight training chain. This is why their competent planning plays a priority role. Results achieved in previous flights must invariably be reflected in the planning table for the following flight day or night. This is one of the factors implied by constant consideration of the individual qualities of pilots. Some time ago we did experience certain difficulties in drawing up the planning table. The problem was that the squadron executives were inadequately trained for this function. For example at the time when Lieutenant Colonel V. Yegin took over the squadron, its planning was methodologically disorganized. The level of professional training of the pilots was not accounted for fully, as a result of which manpower, technical resources and time were wasted. At first the squadron commander yielded to the temptation of immediate success, and he tried to "prod" forward pilots who had just barely assimilated the night program and the class standards. This disturbs the sequence and rhythmicity of the flight personnel's training. For example lieutenants A. Yurchuk and V. Salyuk still had two or three flights to go before completing their quotas, and B. Ginkul and N. Gareyev had much more. Meanwhile the commander reduced the flying load mainly of these pilots. Thus the training of combat pairs, flights and squadrons was being held back.

The problems of accounting for the level of flying skills were discussed by the methodological council. The accounting had to be organized in such a way

that it would visually and simply reflect the true state of affairs in relation to all indicators. Such a system was developed by joint effort. Graphs were drawn up which, supplementing one another, fully revealed the real flight training level of the airmen in the subunits. These graphs are convenient and simple, and every commander, on copying them down in his notebook, is prepared to provide an exhaustive reply on the progress of combat and political training at any moment. As an example a graph showing the level of aerial skills consisting of written entries and boxes does not provide a full impression of the progress of combat training. This is why it is supplemented by graphs showing fulfillment of the plan (in figures and in stages) of training the flight instructor staff, of preparations for classroom work and other functions. Together, they provide the fullest possible impression of the effectiveness of the training process. Naturally, preparing such documents requires time. But these investments are paid back a hundredfold. Extensive and efficient information exchange makes it easier to draw up the flight planning tables.

No one experiences any planning difficulties today in our unit. Planning begins with analysis of plan fulfillment in relation to different types of flight training on every flying day (night). The achievements of the personnel are determined at a flight critique, and on this basis we determine the tasks of the squadron, the flight, the pair and each pilot in the next flights. In this case we turn our main attention to simultaneous training of groups capable of executing some particular mission. Experience has shown that subunit commanders who form pairs and flights right at the start of flight training are able to complete the program in shorter time.

Flight training is a multifaceted process requiring exceptionally high organization, thorough preparation and high quality support, especially meteorological. The weather is unstable in spring as a rule. And in order that flight training could proceed without interruptions, strictly according to the plan, commanders should be maximally attentive in their analysis of the weather situation, and they must penetrate deeply into the results of each sortie, accounting for the individual training level of each pilot. When organizing the training process, we must try to see that not a single minute of flying time is wasted, and that time is used with maximum effectiveness to improve the professional skills of the airmen, to strengthen the combat readiness of the subunits and to raise flight safety.

The winter training period is coming to an end. During it, the airmen of our unit achieved certain successes in combat and political training, and they honorably satisfied the socialist pledges they adopted. Deeply recognizing their personal responsibility for the results of their labor, they are improving their professional skills and decisively implementing the requirements of the 26th CPSU Congress on strengthening the defensive power of the country and its glorious air force.

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TECHNICAL SERVICES: SUPPORT TO UNIT OFFICER'S INITIATIVE DESCRIBED

Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 4, Apr 82 (signed to press 3 Mar 82) p 15

[Article by Capt Yu. Sopin: "Initiative of the Airfield Technical Service and Maintenance Duty Officer"]

[Text] Concluding the officer conference, the commander of the separate airfield technical maintenance battalion said:

"You must relate to the forthcoming flying with all due responsibility. I appoint Captain Technical Service Kaz'min as the ATO [airfield technical service and maintenance] duty officer."

Vladimir Petrovich Kaz'min is known in the collective as an energetic and resourceful officer. No matter what assignment the command gives him, he always fulfills it diligently, conscientiously and vigorously. This time, having received the task of providing material-technical support to the flying, Kaz'min met with the flight leaders at the appointed time and analyzed the content and features of the forthcoming flight shift. He was interested primarily in the quantity of airplanes that were to participate in the flying and the nature of the exercises to be conducted by the crews in the air.

Vladimir Petrovich has had to perform the responsibilities of ATO duty officer many times in the years of his career. He possesses sufficient experience. Still, he prepares thoroughly for all flying, recognizing that an efficient rhythm of flying and successful fulfillment of the planning table depend in many ways on the initiative and efficiency of the airfield technical service and maintenance duty officer. After all, he is the one responsible for coordinating and directing the efforts of rear services specialists into the required channel--those who fill the airplanes with fuel, nitrogen and various fluids, start up the aircraft and tow them. The functions of the ATO duty officer also include monitoring compliance with safety measures during work at the airfield, the discipline of rear services soldiers and much else. And Kaz'min has assimilated his responsibilities well.

He has demonstrated to himself many times that even the slightest violation of the rules, especially at night, can lead to breakdown of aviation equipment and support resources, and sometimes even to accidents. Foot traffic and the

travel of prime movers and special motor transportation in other than the designated areas are especially dangerous during night flying. Such violations complicate the actions of the group leader and threaten flight safety. If energetic steps are not taken to keep the airfield policed, the situation is made more complex for the flight crews.

Before leaving the motor pool Officer Kaz'min gets together with the subunit commanders not only to thoroughly check out the condition of the service vehicles and their number but also to thoroughly brief the personnel that are to support the flying. He prepares for such briefing seriously and thoroughly each time. He invariably reads the appropriate documents and studies the order of organizing the flying and its material-technical support. He prepares a list of soldiers that are to work at the airfield on that day. He talks with each one personally, motivating them to achieve the best results.

During such discussions Communist Kaz'min tries to reveal the potentials of his subordinates and to prepare them psychologically for the flying, and he tests how well they know their functional responsibilities. And while the flying is going on, he notes the best experience and the diligence and initiative of the soldiers.

As a result of such observations, by the time the flying ends his notebook is filled with notes about the actions of each specialist. The values of these notes lies in that they help him to analyze the labor of the soldiers well immediately after the flying, and to objectively evaluate the personal contribution of each to the overall success. An exacting but objective evaluation encourages soldiers to participate in further productive training, and it elicits their desire to compete with their neighbors. And competition stimulates growth in the effectiveness of the military labor of rear services specialists during flying.

Captain Technical Service V. Kaz'min knows people well, he distributes them competently among the different items of equipment, and he organizes unweakening control over their actions.

As we know, unforeseen circumstances may also arise in the course of a flight shift. It is often the responsibility of the airfield technical service and maintenance duty officer to find the right solution in such cases. When faced by a complex situation, he must clearly determine what to do to prevent interruptions in the filling of the aircraft with fuel, oxygen, nitrogen and special fluids.

Once the fuel supply was cut off unexpectedly in the course of preparing airplanes for a turnaround sortie. This is an extremely rare case. It turned out that a rubber gasket failed at the central fueling station. Being the ATO duty officer, Captain Technical Service V. Kaz'min acted resourcefully and decisively: He quickly organized fueling of the airplanes using fueling trucks, and he took energetic steps to correct the problem. Specialists led by the chief of the POL service soon arrived at the central fueling station and returned its work to normal.

As we know, not only the quality of material-technical support to flying but also the general mood of the specialists depends on the ATO duty officer. Delivery of hot food to the airfield on time, exemplary order at food dispensing points, timely provision of transportation for flight crews, engineers and technicians, and many other problems within the responsibility of the ATO duty officer obligate him to work resourcefully, at peak effort. So it is with Communist Kaz'min. When he is the ATO duty officer, the airmen relax: They know that the rear services specialists will not let them down.

This training year is the jubilee year. It is filled with intensive labor. Specialists of the separate airfield technical maintenance battalion are making a substantial contribution to improving the professional skills of the airmen and their combat readiness. Analyzing the results, the battalion command is making known the unsolved problems and unutilized reserves. Exactingly evaluating the personal contribution of each soldier to high-quality flight support, the commander and party organizations are doing everything they can to publicize the experience of the best officers and to improve the professional training of all specialists, and of the ATO duty officers in particular. A decision was made to set up a display in one of the classrooms devoted to the leaders of the socialist competition, among the best of whom we find Communist Technical Service V. Kaz'min.

Recognizing the complexity of the forthcoming missions, the personnel are striving to secure their accomplishments and to ensure higher quality in the combat training of airmen in the year of the 60th anniversary of formation of the Union of Soviet Socialist Republics.

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FIGHTERS: ATTACK TRAINING FOR VERTICAL MANEUVERS

Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 4, Apr 82 (signed to press 3 Mar 82) pp 28-29

[Article by Engr-Col S. Bytko, candidate of military sciences, assistant professor: "Recovering an Airplane From Vertical Maneuvers"]

[Text] Performing maneuvers in the air when training in aerial combat or when attacking ground targets, the pilot controls the airplane in a broad range of altitudes, speeds and angles of attack. In some phases of vertical maneuvers these parameters come close to their maximum permissible values, ones which must not be exceeded. Piloting errors at such moments can threaten flight safety. The situation is made even more difficult by the fact that when the range of altitude is limited, for example, when attacking a ground target, the pilot must make sure that his piloting is not too passive on one hand and not excessively aggressive on the other. In the first case the principal concern is to create optimum sighting and firing conditions, while in the second case keeping within the permissible angles of attack is paramount.

Let us examine the conditions under which an airplane's trajectory is bent in the vertical plane.

As we can see from Figure 1 on the outside back cover [figure not reproduced], the trajectory is bent in response to centrifugal force F_c, equal to the difference between the projections of the lifting force and of the force of gravity on the normal axis:

$$F_c = Y \cos \gamma - G \cos \Theta.$$

When the projections of the forces are equal, $Y \cos \gamma = G \cos \Theta$, angle Θ remains constant during the maneuver--that is, the airplane flies in a spiral or ascends in a straight line with $\Theta = \text{const}$. When $Y \cos \gamma > G \cos \Theta$ the trajectory is bent in such a way that angle Θ increases, while when $Y \cos \gamma < G \cos \Theta$, angle Θ decreases. This means that to create the required angle of climb (descent) the pilot can change the value of component $Y \cos \gamma$ by reducing or increasing acceleration (the angle of attack), the angle of roll, or both together.

When n_y and Θ are kept constant, increasing the angle of roll an amount greater than necessary for spiral flight, γ_{sp}, causes G cos Θ to exceed Y cos γ and the airplane's angle Θ would decrease. But when $\gamma < \gamma_{sp}$, on the contrary angle Θ would grow. That is, recovery from a climb or initiation of a dive at $\Theta < 90°$ is associated primarily with a decrease in component Y cos γ relative to the projection of G cos Θ.

To increase the intensity of bending of the trajectory at the moment of recovery from ascending maneuvers, the pilot should first increase the angle of roll and then, depending on its magnitude, reduce or increase acceleration. Thus when $\gamma \leqslant 90°$ the intensity of trajectory bend downward would increase as the acceleration decreases. And on the other hand when $\gamma > 90°$, when Y cos γ assists the force of gravity component G cos Θ in bending the trajectory (Figure 1*b* on outside back cover) and when $F_c = Y \cos \gamma + G \cos \Theta$, an increase in the intensity of maneuver would require an increase in acceleration n_y. In this case the greater the angle of roll and acceleration, the more intensively the trajectory is bent.

To reproduce the phases of ascending maneuvers, let us turn to the graph analysis method of simulating maneuvers, particularly to the appropriate nomogram (AVIATSIYA I KOSMONAVTIKA, No 6, 1980). To make things easier to see, the right and middle quadrants of this nomogram are shown in enlarged scale on the figure on the outside back cover. The right quadrant shows the limits of V_{min} in relation to $C_{y_{perm}}$ for altitudes of 2,000 and 5,000 meters for an airplane with specifications as shown in that figure. We will examine the procedure of solving this problem using, as an example, determination of the parameters for recovery of an airplane from a climb ($\gamma = 0°$) into horizontal flight with the following initial recovery conditions: $V_0 = 600$ km/hr, $H_0 = 5{,}000$ meters, $\Theta_0 = 30°$, $n_y = 1.5$. In this case the angle of roll is 60° for recovery from a chandelle and 120° for recovery from a climbing half-roll.

First let us find the angular velocity component, which is determined by mass forces for the mean angle Θ_m, which in our case is equal to 15°--points *a-b-c* (Figure 2 on outside back cover [not reproduced]): $\omega''_{vert} = (g/V) \cos \Theta$. At point *c*, component $\omega''_{vert} = 3.3°/sec$.

The vertical component of angular velocity, which depends on the action of superficial forces, is found at point *f*, and it would be equal to:

$$\omega'_{vert} = (g/V) n_y = 5.1°/sec.$$

We plot the value of ω''_{vert} on the abscissa in the left quadrant (point *c'*). From it we extend a vertical line to its intersection with the continuation of line *e-f'* at point *k*, the position of which determines the angle of roll necessary to complete a spiral turn with $\Theta_m = 15°$ and $n_y = 1.5$. In this case the angle of roll would be 52°. When the angle of roll is $\gamma = 60°$, the projection of vertical velocity at $n_y = 1.5$ is $\omega'_{vert} = 2.6°/sec$ (point *f'*), and angular velocity would be: $\Delta\omega_{vert} = \omega''_{vert} - \omega'_{vert} = 3.3°/sec - 2.6°/sec = 0.7°/sec$. Consequently in this case the time for recovery from a climb would be

$\Delta t = 30/0.7 = 43$ sec--that is, it would be impermissibly large. As was noted earlier, it could be reduced by decreasing γ or increasing n_y.

We can see from Figure 2 on the outside back cover that at $\gamma = 60°$, a decrease in n_y to 0.5 (point *m*) causes a decrease in Θ'_{vert} to 0.8°/sec (point *m'*), such that $\Delta\omega_{vert} = 33.3-0.8 = 6.5°/sec$, and Δt decreases to 12 sec. When we create a situation where n_y equals zero, $\omega'_{vert} = 0$ and $\omega''_{vert} = \Delta\omega_{vert} = 3.3°/sec$, and $\Delta t = 9$ sec. The same effect can also be achieved by increasing the angle of roll to 90° (at $n_y = 1.5$), inasmuch as in this case as well, $\omega'_{vert} = 0$ (point *f*).

It should be noted that in the case under examination here, we did not account for the time necessary to create the necessary angle of roll and to reduce it in the end of the phase. Therefore we should add the time spent on inducing roll and eliminating it to the time for recovery from ascending maneuvers. The rate of roll of a maneuvering airplane is about 60°/sec, and therefore in the recovery phase, for example following a half-roll, we should add, to the found time of change of angle Θ, the 6 seconds required for the half-rolls at the beginning and the end of the maneuver. It may turn out that the found time exceeds that required to initiate a dive, or it may be found to be comparable to it. What is important to the pilot is that reduction of the overall time of dive initiation requires the most energetic possible action in the phases of creating and reducing roll. At these times, angular velocity should be increased up to the maximum possible (90°/sec). In the example under examination here the time to create and then reduce roll when recovering from a chandelle with $\gamma = 60°$ is significantly less than the time of the principal phase, and the rate of change of roll does not have a practical influence on the total time.

Note that we must reduce the time required to perform combat maneuvers if we are todecrease the total time the attacking aircraft is within range of the enemy antiaircraft resources protecting the target. Moreover the less this time is, the less the speed changes during recovery from ascending maneuvers, inasmuch as

$$\Delta V = g(n_x - \sin\Theta)\Delta t$$

and this means a lesser danger of going beyond α_{perm}. If we achieve a roll of $\gamma = 120°$ at $n_y = 1.5$, then ω'_{vert} would be equal to -2.6°/sec, $\Delta\omega_{vert} = 3.3 + 2.6 = 5.9°/sec$, and $\Delta t = 5$ sec. The total time would be 9 sec. Naturally this time and acceleration n_y could be reduced by increasing roll to 180°. However, care should be taken not to exceed α_{perm}.

Using the nomogram we can also determine the parameters of initiation of a straight dive (without rolling) such that near-zero or negative accelerations are created.

In this case the order of finding ω'_{vert} and ω''_{vert} remains as before, except that it should be remembered that the two components should be added in this case. Determination of ω_{vert} and the maneuver time will be left to the reader.

Knowing the time of maneuver, using the nomograms (AVIATSIYA KOSMONAVTIKA, No 4, 1980) we can determine the loss of velocity, and using the nomogram shown in issue No 3 for the same year we can determine angular velocity and consequently the airplane's turning angle in the horizontal plane. Next we can determine the turn radii of the airplane in the horizontal and vertical planes, and its longitudinal and lateral displacements, as well as its loss in altitude during recovery from an ascending maneuver. In other words we can graphically reproduce the airplane's trajectory in the horizontal and vertical planes. In this case the pilot must constantly take care not to exceed α_{perm}, with a consideration for change in velocity during the maneuver.

Thus at $H_0 = 5{,}000$ meters and $V_0 = 600$ km/hr, only a maneuver with $n_y < 0.8$ (see figure on outside back cover) would ensure safe flying ($\alpha < \alpha_{perm}$) for a pilot maintaining the prescribed acceleration with a precision of $\Delta n_y = \pm 1.0$. Pilots flying with a precision of $\Delta n_y = \pm 0.5$ may maintain an acceleration of $n_y = 1.3$ while maneuvering.

We examined the case of recovering from an ascending maneuver at an initial angle $\Theta_0 = 30°$. In those cases where angle Θ exceeds 30° it would be suitable to determine the parameters of the maneuver in relation to individual sections not exceeding 20°-30°. For example when recovering from a maneuver with angle $\Theta = 50°$, we would first need to examine the range of angles $\Theta = 50°$-30° with a mean angle of $\Theta_m = 40°$, and then the range of angles 30°-0° with $\Theta_m = 15°$, and so on.

We should note in conclusion that when necessary, all parameters of the phases of straight flight during climbing, diving and recovering from a dive, including "dipping" of the airplane, may be determined with the aid of the nomogram (AVIATSIYA KOSMONAVTIKA, No 4, 1980).

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FIGHTERS: INTERCEPTER TACTICAL TRAINING DISCUSSED

Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 5, May 82 (signed to press 31 Mar 81) pp 4-5

[Article by Col Yu. Ivanov, military pilot 1st class: "The Tactical Skills of an Air Warrior"]

[Text] The combat control officer did not see the return from the target right away. Competently utilizing the terrain, the "enemy" kept himself outside the field of view of the radar station as much as he could. Immediately after he was detected, the commander ordered Guards Captain Ye. Kaburov's flight to take off.

Catching up to each other, the airplanes assumed a course toward the target region in an open combat formation. Following the commands of the command post, the flight turned left, then right and once again assumed its previous course. "The navigator's nervous," Kaburov thought to himself. "He should be looking both ways...."

The premonition did not deceive the leader. Because of the combat control officer's mistake the flight encountered the target much too early, on an intersecting pursuit course. Guards Captain Kaburov saw the fighters cross over him from the left, and he realized that his pair was in a tactically disadvantageous position. Were he to order the airplanes to maneuver for the attack as a flight, they would lose precious seconds. Estimating the situation, Kaburov made a decision.

"Six Three Zero, attack!" was the command transmitted to Guards Captain A. Chaplinskiy, whose pair was traveling a certain distance behind the leader and was in better conditions.

Understanding the commander's plan, Chaplinskiy initiated an energetic turn to the right. Finishing its maneuver, the follower pair made an accurate strike. The aerial duel was won. Analyzing the actions of the flight of four on the ground, the senior chief made note of the tactical maturity of the pilots and their ability to correctly solve a problem.

In conditions where the flight characteristics of the aviation equipment of opposing sides are approximately equal, the tactical skills of the air warriors

acquired decisive significance. Assume that two pilots have had identical flight training, that they are equally trained in the tactics of aerial combat and that they know how to fire on different kinds of targets. Can we confidently say that they are worthy rivals? It would be difficult to answer this question categorically, since even among masters of aerial combat, there is always a winner and a loser. A draw rarely occurs.

Detailed analysis using materials from flight recorders makes it possible to reveal when the loser made his mistake and determine how it could have been avoided. As a rule he who is faster and more accurate in creating a mental picture of the three-dimensional pattern of combat, at selecting from the available arsenal of tactics the one suited to the evolving situation and at making an effective strike will win. Analysis of such flights permits the commander to reach conclusions about the tactical thinking of the pilot, while the air warrior is aided in selecting the best variant of attack or the best way to evade an attack in comparable conditions. In other words a situation is created where, in a similar situation, the pilot would be able to seize the initiative in the air. Cunning, boldness and daring, reinforced by high professional and tactical training, predetermine success in combat. This was proven by the experience of the Great Patriotic War and by life itself.

Discussing different variants of combat in tactical training sessions, pilots learn how to solve problems not only for themselves but also for the opponent. In this case they try to place the adversary in a more advantageous position at each of the phases of an encounter. This procedure helps to shape tactical thinking and develop initiative and decisiveness. Tactical training sessions have rightfully assumed a worthy place in the system of training afforded to air warriors.

Proficiency comes with time. Where training and indoctrination of pilots is conducted in integration, and where simultaneously with improving piloting skills they are taught to think with tactical competency, development of air warriors proceeds much quicker. A good training base and a highly qualified instructor staff ensure rhythmicity and continuity in the combat training of the airmen. This is understood well in the collective led by Guards Major V. Smirnov. Much attention is devoted here to the skills of the flight commanders, and an effort is made to see that each of them becomes a good instructor, teacher and tactician.

Many new things have appeared in the procedures used in the training of winged warriors with the appearance of modern equipment. But the "do as I do" principle has remained unchanged. In order that subordinates would not become confused, flight commanders study beforehand the exercises that are to be conducted on the ground and in the air, they dig down to the essence of each particular phenomenon when the training involves aerodynamics, and they learn to adequately prove the correctness of their actions when the discussion turns to tactics. In other words training is structured in Guards Major Smirnov's squadron according to the rule: As you teach others, teach yourself.

The flights prepare especially carefully for squadron tactical flying exercises. Planning a tactical flying exercise, commanders try to organize it in such a way that the situation would maximally correspond to real combat. This raises the responsibility of the pilots for personal training, mobilizes them to fulfill their principal mission and teaches them to work independently.

As an example Guards captains Ye. Kaburov and A. Nekhayev organize their work in the following way. After the squadron commander poses the mission they present concrete assignments to the followers. Each pilot develops his own variant of aerial combat or a strike against the ground target with a consideration for the possibilities of his fighter, the nature of the terrain and the antiaircraft resources in the area under consideration, the order of fire and tactical interaction in the pairs and in the flight, and many other questions. Then all of the proposals are discussed. Each officer asks questions and suggests inputs which receive substantial responses in the course of the discussion. Sometimes the intensity of the discussion rises, but as the saying goes, truth is born out of debate. Under the flight commander's guidance the pilots create a mental model of the forthcoming battle, flesh out its details and determine the order and signals of interaction. Much attention is devoted to the different variants of entering into combat and breaking away from combat depending on the situation and the amount of fuel remaining. Thus all pilots of the group participate in the choice of the method of action in correspondence with the situation. The order of work in the air need not be explained to them later on, because everyone is already cognizant of it. As a rule the main variant is played out until such time that all pilots understand it fully.

Then the group performs the assignment by the "dismounted air training" method using a planning stage. Holding model airplanes in their hands, the pilots play out the entire flight, and they work out coordination in the different flight phases in response to specific inputs. An obvious inconsistency would seem to be present here--between a modern fighter outfitted with electronic systems and unpretentious wooden models. But this is not so. If an air warrior firmly knows how the locations of airplanes change within a group performing a maneuver, he is able to orient himself in an altered situation faster and to make the right decision. Therefore the "dismounted air training" method of playing out an assignment is not an anachronism, as some airmen feel, but a fully justified, life-tested, effective teaching tactic.

When checking the preparedness of the flight crews for a tactical flying exercise, the squadron commander determines how well the subordinates know the assigned missions and the suggested ways of completing them, as well as the countermeasures that the "enemy" might take in a given situation. The advantages of the method used to prepare for tactical flying exercises practiced in flights commander by Guards captains Kaburov and Nekhayev are obvious. In addition to outstanding knowledge of the "enemy," his tactics and their own capabilities, the pilots demonstrate their ability to think broadly and with tactical competency, they do not lose self-control on receiving a complex input, and they are able to find the most sensible solutions independently. Moreover their responses are precise and concise. Sometimes it seems

that the responding pilot has before him a drawing of the battle, and that he fills in the details as the inputs come in.

Critiques of training air battles, in which the actions of each pair and of each flight are evaluated, have important significance to raising the tactical skills of the pilots. Onboard and ground flight recorders are prepared beforehand for the critique, and they are used to their fullest possible extent. In this case the commander does not simply list the successful or unsuccessful actions of the airmen; instead, he deeply analyzes the causes of successes and failures. This is a real school of tactics and of the best experience. As an example Guards majors B. Belichenko and A. Shpikin and Guards Captain N. Gordiy acted competently at a recent squadron tactical flying exercise. They described the details of their actions in aerial combat at the flight critique. The pilots received an object lesson in efficient, tactically competent work in the air.

Guards Senior Lieutenant V. Simonenko also shared the joy of his last victory in the sky with his comrades. The situation evolved in such a way that he was unable to use his radar sight to attack his target in the stratosphere, but the pilot competently used a back-up sighting system and managed to make an accurate strike despite the fact that time was short. His outstanding professional training and deep knowledge of the aviation equipment permitted him to orient himself in time, and complete his assignment.

Great and complex tasks face the collective headed by Guards Major V. Smirnov. Of course, there are still many unsolved problems, but there is no doubt that the airmen are capable of fulfilling the plans. A spirit of rivalry, sights set on a high end result, and good planning of combat and political training are promoting rhythmicity in the work and mobilizing the squadron personnel for unconditional fulfillment of socialist pledges. A good training base, deep technical and special knowledge and the firm moral-psychological tempering of the air warriors, combined with firm piloting habits, permit them to confidently assimilate complex forms of training and improve their flying proficiency. In this case the commanders and the party and Komsomol organization of the subunit are devoting special attention to questions of tactics. Everything new and progressive found in training aerial combat and in tactical flying exercises is brought to the awareness of every airman and used in further combat training in the interests of raising combat readiness.

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FIGHTERS: TACTICAL VALUE OF FIGHTER PAIRS DISCUSSED

Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 5, May 82 (signed to press 31 Mar 82) pp 22-23

[Article by Col A. Dashin, military pilot 1st class: "The Strength of a Pair Lies in Its Tactics"]

[Text] Many works have been written on the tactical unity of the pair. However, the question "A pair or one?" posed by Colonel V. Belyayev (AVIATSIYA I KOSMONAVTIKA, No 11, 1981) presents certain interest.

The author of the article came to the conclusion that the time has supposedly come to abandon the pair as the main combat formation seen in fighter groups of different compositions, and to recognize the sole fighter to be the fire and tactical unit. It should be noted that with the advent of fighter aviation, the sole airplane became the fire unit, and the combat use of fighters began with their application as individuals. By this time--this was during World War I--innovative pilots had generalized the experience of combat flying and their own combat activity at the front, and did a great deal to develop the fundamentals of tactics and the organizational structure of fighter subunits.

Ye. Kruten', a student of the outstanding Russian pilot P. Nesterov who had knocked down 20 enemy airplanes in the war, untiringly sought the most effective means of fighting enemy aviation and creatively developed the tactics of aerial combat. It is interesting that it was at that early date, when he was just the commander of the 2d Air Fighter Detachment, he wrote the following in "Creation of Fighter Groups in Russia": "In every detachment, the pilots must work together in the pairs in which they will be flying on patrol, so that they could recognize one another easily." According to his views every detachment had to undergo flight training in paired units. And in the pamphlet "Aerial Combat" he recommended how a pair of fighter should attack: "Either they should both charge the enemy craft: One should distract the enemy by climbing from behind on a zig-zag course in such a way as to avoid being hit by the observing aircraft, and during this time the other should dive from above, firing upon the enemy; or both should symmetrically attack from the sides, dividing the enemy's attention; or one should attack while the other protects his rear from attack by another enemy airplane."

Creation of large air forces in the leading countries of the world in the 1930s necessitated development of the theory of their combat application. The flight of three airplanes was made the foundation of the organizational structure. In this connection fighter tactics developed on the basis of using such flights in aerial combat. Was this justified? To a certain extent yes, if we base the answer on the criterion of high fire density. And only on that condition. But there were other ways by which fire density could be increased. Later on, as a result of the search for effective ways of using fighters in combat, the flight of three airplanes had to be abandoned for the pair.

Therefore, examining the dependence of tactics on equipment and weapons, we must always consider the evolutionary and revolutionary factors of their mutual influence. This is reflected both in the constant improvements of combat tactics (the influence of the evolution of equipment and weapons) and in the search for fundamentally new methods and tactics of combat (the influence of the revolution in development of equipment and weapons).

In this case the innovations brought forth by creative thought acquire the right to become a real objective foundation of the mutual relationship between tactics and equipment only after they are confirmed by practice. Obviously, the flight of three airplanes did not pass this test of practice.

During the war, Soviet air warriors came to the correct conclusions as they accumulated experience in group air battles with fascist pilots. This resulted in the appearance of the pair--the foundation of the combat formation, and this is the way new tactics and methods of combat came into being. Tens of thousands of aerial battles persuasively proved the indisputable advantage of the pair.

The combat potential of the modern fighter is many times greater than that of the piston-engined and even the jet aircraft of the first generation. Fundamentally new weapons of aerial combat have been created--missiles having various effective ranges. The fighter pilot can now use a sighting system to observe the airspace great distances away. While in former times he detected an aerial opponent visually and sighted visually, now he does this with the appropriate instruments.

The following question naturally arises in this connection: What would be the optimum combat formations which would be in keeping with the capabilities of the aviation equipment and weapons? Is the author of the article "A Pair or One?" right when he says that the pair has lost its significance as the primary tactical subunit and that it has become a hindrance to realization of the high combat properties of fighters? I think not. And here is why.

First of all a pair is not a simple sum of the greater combat possibilities of single fighters. The pair ensures attainment of significantly greater results owing to tactical advantage. In other words the pair enjoys a new advantage owing to joint action against an aerial opponent in a tactically coherent combat formation, mutual fire support and mutual information on the aerial situation.

The dynamics of aerial combat are extremely diverse. Every change in the situation requires new combat tactics that would be unrepeatable in other situations. But there are some tested principles which should be followed as long as fighters operate in pairs.

Here is an example. Assume a pair of fighters has been raised aloft and committed to combat. For some reason it has been unable to approach the enemy covertly, owing to which surprise has been lost. How is victory to be achieved in this case? Obviously the enemy should be presented with a confused situation, disorganization should be induced in his actions, and his attention should be dispersed. The essence of the tactical unity of the pair manifests itself here in intentional division of the combat formation into single crews, each of which performs its own maneuver, as previously worked out on the ground, intended on one hand to distract the enemy's attention by deceptive actions and on the other to achieve a successful swift attack.

Thus tactical indivisibility of a pair does not mean that we cannot divide its structure, which is something that is especially typical of fighters evading an enemy strike in dynamic combat. And Col V. Belyayev's assertion that the probability of target kill by two single fighters is greater than the kill probability of a pair holds truer at a practice range than under combat conditions.

Second, modern aerial combat has a clearly pronounced group nature. As actions by American and Israeli tactical aviation against ground objectives in local wars have shown, airplanes will be brought together into strike and support groups of significant size irrespective of the striking power of the individual airplanes. They would have to be opposed by groups of fighters of corresponding composition, and their combat formation would have to be in keeping with the plan of battle such that at least some of the forces could forestall the enemy in maneuver to permit accurate use of weapons. In this case--and this is most important--one or several tactical units (and not solitary airplanes) encountering the enemy may find themselves in an advantageous position to attack and to make a sudden anticipatory strike.

This is precisely why the cohesion of pairs and flights must occupy an important plce in the training of flight crews to fight group air battles. But this cohesion has to do not with parade formation, not with "wingtip to wingtip" precision but with tactics: Cohesive combat formations that are open in front and in depth, and disposed in altitude.

It stands to reason that cohesion is a relative concept in combat. A pair, a flight and all the more so a group consisting of several flights must maintain a combat formation which would not restrict the actions of any of its elements. Without a doubt it is more difficult to fight in such formations, and the responsibility of each pilot in the group for its success is significantly higher. What each pilot needs here is a very clear understanding of his role and of the maneuver he is performing. When operating in open combat formations, the follower must not so much repeat the maneuvers of the leader as he should know how to promptly realize his plan and fulfill the necessary maneuver. And this is possible only if the leader and the follower and the group commander and pilots exhibit high tactical competency.

Third, paired flight raises the psychological stability of the crews, especially over enemy territory. The feeling of having a comrade nearby makes it possible to engage in aerial combat more decisively and boldly.

And finally, when airplanes operate as pairs, the traffic capacity of ground control points increases.

All of this confirms that the principle of the paired fighter formation has not exhausted its inherent possibilities, and therefore there are no grounds for abandoning it. How a pair should operate, what tactics and methods of attack it should use in combat and what types and forms of combat formations are most acceptable in different phases of flight and in the dynamics of combat are another matter. This is the range of issues with which commanders and fighter pilots should really be concerned, and for which we must seek the correct responses before the airplanes even get off the ground. The main thing in this case is to competently account for the influence of more-sophisticated sighting systems and qualitatively new weapons upon the type and form of combat formation assumed by the pair or by other large groups of fighters.

Under these flying conditions (for which pilots must prepare psychologically) the functions of the follower and leader are in a sense "equalized," especially at the time of commitment to combat and when breaking away from combat, though the command functions must invariably be left with the leader.

It should be emphasized that aerial combat is still group combat, and victory in it can be ensured by a bold search for new tactics. Tactics is precisely what primarily determines the power of combat equipment and weapons. Only well trained followers and leaders, operating in a combat formation ensuring fire and tactical interaction and excluding the possibility of a surprise attack by the enemy, and displaying decisiveness and aggressiveness in combat, can win in combat, even against superior enemy forces. This is why the tactical proficiency of fighter pilots must be at the center of attention of their commanders, and why developing their creative approach to solving combat problems and instilling will, boldness and persistence should be interpreted as mandatory prerequisites of successful realization of a bold plan.

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FIGHTERS: PSYCHOLOGICAL TRAINING FOR COMPLICATED FLIGHT SITUATIONS DISCUSSED

Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 5, May 82 (signed to press 31 Mar 82) pp 28-29

[Article by Col S. Oskanov, military pilot-sniper; Col Med Serv I. Alpatov, candidate of medical sciences; and Maj Med Serv A. Lastovetskiy, candidate of medical sciences: "When the Situation Became More Complex"]

[Text] Senior Lieutenant V. Goryachkovskiy came in for his landing approach after completing his flying assignment. Suddenly he felt the airplane rolling sharply, a second's delay could have meant an extremely grave situation. "Something's wrong with the flaps" the officer instantaneously determined the cause of the rolling. The pilot retracted them on the spot.

Goryachkovskiy made a normal landing. The air warrior's good training, constant practice of actions in unusual flight situations, a clear idea of possible failures in each phase of a flight and a high psychological preparedness to perform the necessary operations with the cockpit controls helped the pilot surmount the emergency situation in time (it was later found out that it was created owing to mistakes by aircraft specialists). Purposeful training sessions aboard airplanes and in special apparatus were conducted regularly in the unit in which this pilot serves. The regiment's methodological council regularly provided assistance to the personnel in making themselves ready for work in a complex situation.

Flight safety is guaranteed in aviation by the entire scientifically grounded system of flight crew training, flight support and development and production of aviation equipment. Owing to this a rather high level of flight safety has been achieved in the air force. The absolute majority of military pilots never encounter emergency situations in their careers. Nevertheless in view of the unique features of flying, the air warrior must always be prepared to act in difficult unexpected situations. Such preparedness is precisely what has helped airmen successfully walk away from emergency situations.

An airplane piloted by Lieutenant Colonel V. Tkachenko collided with a large bird in the air. The bird punched a hole in the front part of the canopy, and the pilot received many superficial injuries. The conditions within the cockpit became extremely complex. But Tkachenko displayed courage, coolness and self-control. In combination with outstanding professional training, this permitted the officer to complete the flight safely.

In this case the pilot's preparedness for performing immediate and competent operations in response to sudden complication of the flying situation manifested itself to the fullest. Of course, it is practically impossible to train a person directly for actions in such concrete conditions. But proper organization of flying in the unit shaped the pilot's capability for immediately and competently reacting to changes in the situation throughout the entire time of an assignment. The moral-psychological qualities of each pilot were studied attentively in the regiment. It was with a consideration for these qualities that commanders, instructors, political workers, flight surgeons and flight leaders organized their work. The results are obvious.

Preparations for action in a complex situation must embrace all stages of an emergency situation to include, if necessary, rescue. In other words in addition to preparing the pilot to resolve extreme situations in the air, we need to simultaneously prepare the pilot for abandoning the aircraft when the situation assumes an irreversible nature. Practice shows that such preparedness helps the pilot to stay alive when that seems to be impossible.

An old but very instructive fact comes to mind. Two airplanes collided at night. The wing of Captain V. Bortsov's craft disintegrated completely. The pilot received a head injury. The uncontrollable airplane rotated as it fell, and the pointer on the dial swiftly ticked off the kilometers of lost altitude. The considerable accelerations, alternating between negative and positive, tossed the officer from side to side.

Nevertheless Bortsov was able to reach the catapult handle, grasp it and force it toward himself. He did not eject--the canopy would not release due to misalignment of the cockpit, and the action of the firing mechanism was blocked. Losing not a second, Bortsov left his left hand on the catapult handle, stretched his right hand to the manual override lever and ejected himself through the canopy. He acted just as efficiently as he descended and touched down in the presence of a strong wind and as he awaited rescuers on the snowy steppes. In addition to Officer Bortsov's individual traits of character--confidence in his strength, his propensity for decisive action, outstanding physical fitness (he was interested in mountain hunting and rock climbing)--a clearly developed orientation toward rescue and survival in all conditions played a positive role. This orientation was shaped through extensive flying over vast regions offering a harsh climate and a sparse population.

Unfortunately cases of the reverse sort occur in life as well. Sometimes pilots hardly make use of the objectively available reserves to halt the development of unfavorable events. And some of them become confused in response to the slightest increase in the complexity of flying, their confusion bordering on disorganization of aircraft control.

Captain N. Vasilenko is considerably experienced. But here is what once happened to him. The generator began operating unstably in the air. This not only was a threat to safety, but it also created an obstacle to further flying. The pilot became so confused that he committed an entire series of gross mistakes: He was unable to establish communication with the flight leader, he made mistakes in setting the sweepback of his wings, he worked

the landing gear valve incorrectly, he turned off the engine prematurely, and he landed too early. A pilot with good professional qualities would not permit himself to make so many mistakes in his entire career.

What did the critique reveal? Efforts to study the individual features of the pilots were poor in the unit. The instructors frequently permitted the students to advance in the program on the basis of an oral report from the subordinate that everything was proceeding normally, without making sure that he had actually assimilated the particular element of the assignment using the material provided by the flight recorders. The regiment possessed a "Fisiolog-M" instrument used to record the physiological characteristics of the flight personnel as they underwent training. But it was essentially unused.

It stands to reason that preparing a pilot for action in an emergency situation is a multifaceted process. Moreover far from all complex situations can be simulated today. To make matters worse, practically no system of training and indoctrination can provide a full guarantee that the pilot would never make a mistake, and there can be no single solution to the problems encountered by each air warrior. But in the opinion of most aviation commanders and specialists the basic principles of making a pilot sufficiently ready to perform immediate precise actions in complex situations are nevertheless obvious. They include, first of all, constant satisfaction of the established flying time norms, with no significant interruptions in flying, training aimed at predominantly achieving a clear understanding of the essence of flying, a clear and unambiguous impression of the conditions that can place an airplane (helicopter) in borderline flight situations and the ability to avoid them and, if need be, to quickly and correctly rectify errors. One of the key roles is played by thoughtful and systematic training in the detection and identification of emergency situations, since specifically speaking, it is on this that adoption of competent decisions and fulfillment of subsequent emergency actions by the pilot are based.

Practice shows that many useful qualities, boldness for example, cannot be instilled in air warriors effectively without also developing real professionalism in flying. Even excellent mastery of using the catapult chair and good results in parachute training cannot help the individual in some cases if he is unable to correctly evaluate the situation he faces.

As a rule there are other circumstances of important significance as well, among which we should mention, first of all, the pilot's psychological preparedness for the given flight, his predisposition toward the assignment as a whole. In this respect as well we must once again emphasize the significance of the preflight schedule--a unique and very important indicator of the rhythmicity of all of the unit's flight work. A correct combination of work and rest significantly predetermines the pilot's preparedness for a concrete flight.

Some commanders and chiefs still forget this for some reason. Being busy with organizing the flying of subordinate subunits and services, they often find themselves personally unprepared for their own planned flight. Such unpreparedness manifests itself as a rule right in the first phases of flight, or

even earlier--immediately after entering the cockpit, for example during work with its equipment or the flight gear.

Lieutenant Colonel A. Bekhterev had to serve as flight leader one night prior to a flight shift in which he was to fly. Having rested only two and a half hours, the officer returned to the airfield. Before his take-off he had to resolve a few organizational issues. Sitting down in the airplane cockpit, Bekhterev was unable to concentrate his attention: His thoughts, which were focused on a flood of administrative matters, were interrupted by a sense of discomfort and worsening visibility of the instrument panel due to fogging of the faceplate on his helmet. "What's happened?" the pilot thought. Luckily the lieutenant colonel discovered that the oxygen hose had not been connected. Otherwise things could have taken a turn for the worse.

A concerted effort to reveal persons with low emotional stability has important significance to raising flight safety. It was noted long ago that losses in aviation as a result of the crew's confusion are significantly higher than those caused by the direct action of unfavorable factors. This attests to the growing role of developing the ability of flight personnel to mobilize themselves mentally when confronted by an emergency situation, of developing steadfastness even in the face of a worsening situation. At the same time, prompt elimination of various causes leading to excessive nervous tension in the pilot--conflicts in the collective, loss of career motivation, family problems, chronic illness and the like--also acquires important preventive significance.

Use of an instrument that provides psychophysiological data on a person using a trainer, one such as the "Fiziolog-M," can play a special role in evaluating the real level of emotional stability. Moreover because of the relative simplicity of its use, because it is portable and, what is most important, because the information it provides is so valuable, it is a good all-around tool of the flight surgeon. The few technical shortcomings that were revealed in the first stage of operation of the "Fiziolog-M" (this sometimes happens with fundamentally new apparatus used for the first time) cannot be a persuasive reason for reducing the rate of introduction of this instrument.

It is self-evident that if we wish to evaluate the level of a pilot's emotional stability, we would necessarily need to use the data provided by flight recorders, and mainly those which permit comparison of the quality with which the same flight elements are performed under different circumstances.

Creation of an image of the forthcoming actions has important significance to forming psychological readiness to act in an emergency situation. In every labor process, the individual is capable of predicting and planning the results of his future actions. The ability to think them out when "playing out" different situations does not come right away. It depends in many ways on the individual's attitude toward such thinking, and his understanding of its importance and effectiveness, discipline and the pilot's conscious attitude toward his own flight training. In turn, this process itself disciplines the individual, orienting him psychologically toward the flight. This is why such thinking must become a mandatory component of flight preparation.

Thus purposeful preparation of personnel for prompt fulfillment of emergency actions in a complex situation is a realizable and necessary measure raising the reliability of the pilot's activity in all phases of flight, and it is an important reserve of raising the safety and effectiveness of flying assignments. I would like to note in conclusion that all of this also makes it possible to prepare the minds of aviation personnel, and mainly flight crews, for the grim trials of modern warfare, for aerial combat against an experienced, well trained and well equipped enemy, it raises the reliability and effectiveness of the individual in combat equipment control systems, it helps to prevent the arisal of unfavorable mental states, it cements the forces of the air warriors, and it promotes development of deep interest in and a set for outstanding mastery of flying and attainment of high proficiency. This must always be remembered by those who organize and conduct flying and participate in it.

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FIGHTERS: CADET LANDS WITHOUT LANDING GEAR

Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 5, May 82 (signed to press 31 Mar 82) p 30

[Article by Lt Col (Res) D. Baynetov: "The Flight Leader Was Distracted"]

[Text] The cadet flying was coming to an end. The flight leader radioed permission to land to the crews and noted fulfillment of the assignments in the planning table. The future air warriors flew well, and the objectives of the shift were reached almost in their entirety. There were only three airplanes left in the air. And then suddenly....

"This is One One Five, I've finished my third turn, and the right green light doesn't go on," reported Cadet V. Chernyshuk.

"Go around for another pass," the flight leader replied immediately, "check the pressure of the main hydraulic system."

As the airplane flew over the landing strip, one could see from the ground that the right strut of the landing gear was up. The situation had grown complex, but the flight leader acted calmly.

"Raise your landing gear, and then immediately set your valve on release," he ordered.

The strut would not budge.

"What's your remaining fuel?"

The cadet replied. There was little fuel left.

"Take your airplane up, dive, and then recover with a G-force of up to five."

Chernyshuk followed the instructions precisely. While giving these commands, the flight leader thought the situation out. Fuel was running lower and lower. In a few minutes a final decision would have to be made.

"Tell me, how's the strut?" queried the ground.

"The green light is still off, and pressure in the hydraulic system is normal."

There was no longer any hope of lowering the landing gear. "There is one more emergency procedure, but if it doesn't work, he'll never be able to raise the landing gear," the flight leader thought as the tension mounted. "This means that procedure is no good. Moreover it's used when the main hydraulic system fails, and this is a completely different case."

The decision he had to make was the one which would be the most competent, the sole acceptable one in the situation that had evolved. Had an experienced pilot been in the air, he would have landed the fighter on the fuselage with the landing gear up without a second thought. The simplest procedure would be to eject. It is recommended by the instructions. But on the other hand why shouldn't the cadet land the airplane with the landing gear up? After all, he does fly confidently and boldly. "Moreover I could help Chernyshuk by radioing instructions to him," the flight leader concluded. "We've got to act!"

"Report your remaining fuel."

Chernyshuk replied that fuel aboard was minimum.

"Come in for a landing on the back-up dirt airstrip with your landing gear up," the flight leader commanded.

"Roger," the cadet replied.

The attention of airmen at the airfield was riveted upon Chernyshuk's supersonic fighter.

"I'm at my third turn, the landing gear is up."

"Make your approach," the flight leader answered, "and after the final turn, blow away your front strut and extend your flaps."

"Roger."

The airplane looked strange as it approached for a landing without its main landing gear struts. Soon the fighter was on its glide path.

"Engage your air brakes."

The aircraft came closer and closer to the landing strip.

"Level out, turn off your engine."

The airplane touched the ground. The silvery cigar left behind a dust cloud as it moved swiftly over the ground.

"Braking parachute," commanded the flight leader.

A white canopy billowed forth. The fighter stopped. Specialists of the air force engineer service, an ambulance and a firetruck drove up to it. But no assistance was needed. The cadet opened the canopy, and after the technician set the chocks he abandoned the cockpit. Soon the craft was taken away from the dirt airstrip.

What happened to Cadet Chernyshuk was unusual. A serious malfunction that had arisen at the fault of aviation specialists was discovered aboard the fighter. Although it did contain an element of risk, the flight leader's decision was the most competent in the given situation, and the risk was justified: The officer knew quite well that the future pilot was comfortable with the fighter, and he was sure that he would not lose self-control in an extreme situation, that he would fulfill the instructions and recommendations from the ground to the letter.

Of course, by ordering Chernyshuk to land with his gear up the flight leader took on a great responsibility. But he was prepared for this. The officer had studied and trained diligently, and he had analyzed the most instructive cases from practice attentively and thoroughly. When it came time to take on the responsibilities of flight leader, he could provide effective assistance to a pilot or cadet at any moment, and through his efficient and competent commands he could help him get out of a complicated situation successfully.

So it is with most officers responsible for the training of pilots and cadets. They persistently master the technical control resources, they display high exactingness toward themselves and subordinates during flight shifts, they exhibit maximum self-control, and they stick to their principles. But unfortunately cases still occur in which even experienced flight leaders who had failed to issue the necessary command in time do everything they can to blame the pilot or cadet in the critique of the near-accident or error. Understandably, nothing is gained by this, and the behavior of such officers elicits justified reproach. Here is one incident that occurred long ago at one of our school's airfields.

Pilots were refreshing their piloting and combat skills and preparing themselves to fly with cadets after returning from their leaves. Winter was nearing its end. A rather great deal of snow had fallen this year.

The airplane piloted by Senior Lieutenant V. Pavlyuk left for the practice zone with afterburners on. Having completed his intricate piloting exercises, the pilot flew his supersonic fighter back for a landing. The winged craft drew closer to the concrete strip. But not close enough, and it landed in snowdrifts. The fighter suffered some damage.

Many were found to blame for the flying accident, including the commanders of the young instructor pilot , who permitted him to fly solo after a long interruption in flying, without a checkout flight. And the flight leader, Officer G. Alekseyev, did not monitor the airplane's descent, and he failed to tell Pavlyuk to correct his glide path in time after the latter passed the close-in homing radio station.

Alekseyev should have admitted his mistake right away. But instead he tried to show that in this situation, there was nothing he could do to help the pilot, since there was so little time. His conclusions were unfounded. Almost an entire minute passed from the moment the pilot reported releasing his flaps and the moment the airplane touched down. Not a single command from the flight leader could be heard in this time interval on the tape recorder. Why? Had he been attentively observing the gliding fighter, he would probably have seen that Senior Lieutenant Pavlyuk was below the calculated glide path, and he would doubtlessly have pointed out the deviation to the pilot: Officer Alekseyev did have considerable experience as a flight leader by this time, after all.

"I got distracted," he admitted in the end.

The critique revealed another important detail. The runway overshoot areas had not been prepared as required: Rather hard snow was heaped up almost at the very edge of the landing strip. It was in this pile that the airplane got stuck. Officer Alekseyev had not inspected the landing strip and the overshoot areas himself, delegating this job to his assistant. The latter, because of his inexperience, could not competently evaluate the situation, and he said nothing about the snow to the flight leader.

Great and important is the role played by flight leaders in flight safety. There is good reason why so much attention is devoted to their constant and thorough training. But even officers of this category must always be on guard, they must always be at peak readiness when performing their official duties.

11004
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FIGHTERS: TACTICAL FLIGHT MANEUVERS DISCUSSED

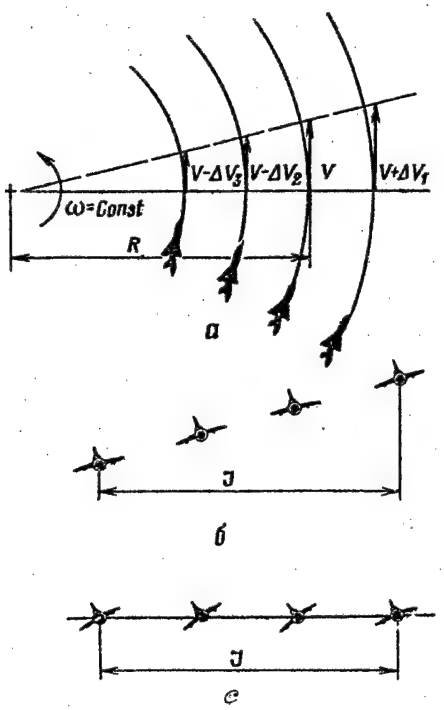
Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 5, May 82 (signed to press 31 Mar 82) p 35

[Article by Engr-Col S. Bytko, candidate of military sciences, assistant professor: "Maneuvering in Formation"]

[Text] A pilot's maintenance of his position in the combat formation of a group of airplanes is based on maintaining prescribed vertical spacing, interval and distance (angle of alignment). The flying characteristics of airplanes in a group differ from the characteristics of a solitary airplane. The problem is that to maintain his position in the formation, a follower needs a reserve of engine thrust ΔP and some leeway in his angle of attack $\Delta\alpha$. When a turn is made in close formation, all airplanes must travel at the same angular velocity, and in this case the preserve thrust permits the outer followers to move along at greater radii and speeds. Moreover a follower needs reserve thrust to compensate for the continuous fluctuations in distance, interval and vertical spacing of airplanes in the group. At the same time the reserve in angle of attack C_y permits the inside followers to turn at lower velocities and smaller radii than the leader while maintaining the same angular velocity. In all cases, however, the angle of attack must not exceed its permissible limit.

Let us examine how the maneuvering properties of a group of airplanes change in maximum-performance maneuvers, which are defined as turns of the leader requiring the followers to maintain their place in formation at α_{perm} or V_{max}. Assume that the group is making a maximum-performance "wheel" turn in close formation. In a wheel turn, the airplanes travel at the same angular velocity but on different radii and at different forward speeds (see figure).

We can use a nomogram bearing the limits for turns in the horizontal plane by a solitary airplane at a given altitude to make the calculations for the limiting conditions of a maneuvering group. For example assume that a flight bearing to the left with a formation breadth of $I = 150$ meters is turning in the direction of the followers at an altitude of 1,000 meters. In this case for the sake of safety the leader pilots his craft with an angle of attack less than that permissible for a solitary airplane. Its magnitude is determined on the V_{min} curve in relation to α_{perm} (see figure on outside back cover [figure not reproduced]) for a solitary airplane; this is treated as the maneuvering limit in relation to α for the innermost follower.



Methods of turning airplanes in a group: *a*--"wheel" turn; *b*--turning with the formation on a tilted plane; *c*--turning at the same altitude in parallel planes.

At an arbitrary point A of this boundary we find angular velocity $\omega = 8°/sec$ (point f) and radius R = 1,200 meters (point A'). Using this angular velocity, we mark off the value of the cumulative interval (total breadth) of the formation, I, leftward (toward the outside of the formation) in the left upper quadrant on the horizontal line AfA', and we get the velocity and radius of the leader's maximum turn (R = 1,350 meters and V = 680 km/hr, point B'). Using this same line and the intervals between the airplanes, we can determine the velocities and turning radii of each of the followers in the group.

Knowing the forward and angular velocities, we find the conditions (acceleration, roll) ensuring a safe maximum-performance turn by the formation (point B) for each airplane of the group in the right upper quadrant. Similarly we determine the other points, and we plot the limit for the maximum-performance turns made by the lead airplane or the entire group. Using the lower quadrants of the nomogram we find the angles of attack (C_y) which must be maintained by the leader.

To evaluate the maximum parameters for a turn by the group in the direction of the leader (away from the followers) we use the curve for maximum steady-state turns by a solitary airplane in the upper right quadrant of the nomogram, adopting this curve as the limit of maximum steady-state turns for the outside follower (see figure on outside back cover).

As in the previous case, using point M as an example and known ω and V, we find the turning radius of the outermost airplane of the group (R = 2,500 meters,

point M′). Marking off the breadth of the formation inward from M′ (for $\omega = \text{const}$), and keeping in mind that the outermost follower is turning at maximum engine rpm, we get the velocity of the leader (point N′, V = 1,000 km/hr). Using this velocity and $\omega = \text{const}$, we find, in the upper right quadrant, point N defining the conditions (acceleration, roll, velocity) for the maximum-performance turn of the leader and, consequently, the group. Using the appropriate documents, for example the instructions on calculating the range and time of flight associated with these conditions (V, H, n_y), we need to determine engine rpm of the lead airplane that permits a steady turn, and plot it on the graph.

Having calculated a number of points on the curve for maximum-performance steady-state turns for the outermost follower (line MM″), we find the limit of maximum-performance turns and the corresponding engine rpm of the lead airplane, and consequently of the entire group (line NN″).

We can conclude in the final analysis for this example that when turning in the direction of the followers, the leader must not exceed $C_y = 0.55$ (the angle of attack in relation to UUA [not further identified]), and when turning in his direction (away from the followers) he must not increase his rpm over 93 percent.

These calculations do not allow for tolerances in relation to α_{perm} and ΔP permitting maintenance of the group formation. Therefore we need to consider some range of deviations ($\Delta\alpha$ and ΔV) within which flight safety is not jeopardized. In the general case we can impose additional limits spaced a distance from those examined above equal to the tolerances required for maintaining one's place in the formation.

The calculations made with these graphs once again show that the maximum maneuvering possibilities of a group of airplanes flying in close formation are significantly lower than those of a solitary airplane. A significant worsening of maneuverability may be avoided by flying in open combat formations in which the follower airplanes assume an opposite bearing as the leader maneuvers in relation to them. In the case of high speeds the outer followers intersect the path of the leader and switch to the inner side of the turn, while at low speeds the inside followers drift to the outside and maintain the necessary interval and distance while not exceeding the limitations set by α_{perm}.

However, even in this case the leader cannot fly at the performance limits of a solitary airplane, since the followers still need a reserve of engine thrust and angle of attack to keep their place in the combat formation and to compensate for errors in piloting technique. However, these reserves would be lower for an open formation than a close one. In other words the maneuvering possibilities of a group flying in open combat formations would be higher than a group flying in close formations but lower than for a solitary airplane.

The material presented in this article permits evaluation of the extent to which the formation in which airplanes fly influences the maneuvering characteristics of the group, and how this could affect its combat possibilities. Moreover a possibility appears for designating the limiting flight conditions for the leader, and consequently the entire group, as required by safety considerations, before flying begins. A firm knowledge of these conditions will raise the safety of all formation flying.

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ROLE OF FLIGHT INSTRUCTOR DISCUSSED

Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 5, May 82 (signed to press 31 Mar 82) pp 40-41

[Article by Lt Col A. Tokarev, squadron commander, military pilot 1st class: "The Instructor's Experience"]

[Text] As we know, the instructor plays the principal role in the development of the beginning pilot. The novice's success in assimilating complex aviation equipment and acquiring flight proficiency depends mainly on him.

The 26th CPSU Congress emphasized the significance of the executive's high personal responsibility for the success of his assigned work. The party's requirement also pertains to officers, who bear the full responsibility for the training and indoctrination of their subordinates. Irrespective of the position he occupies, the officer-teacher must possess a feeling for the new, he must not yield to complacency and self-satisfaction, and he must not lose his perspective. Life does not stand in place. It imposes increasingly more complex tasks upon the executive.

Most instructor pilots of our higher military aviation pilot school work productively. They persistently instill high moral-political and psychological qualities in the cadets and competently teach them flying. Deserved authority is enjoyed, for example, by flight commander Major N. Kozlov. In his work with cadets he relies extensively on the recommendations of military psychology and pedagogics. The officer is firmly convinced that deeply thought out practical utilization of scientifically grounded procedures is a dependable means of ensuring high quality fulfillment of training programs and plans. There is something else that is no less important. The flight commander competently instills initiative in his subordinates. Its vital force is necessary in all things, and especially in learning how to fly. Major Kozlov patiently instills independence in his cadets, and he develops their aggressiveness, utilizing various resources. He meticulously studies the psychophysiological characteristics of his subordinates and their individual features and interests. The information he obtains helps the instructor use the problematic approach in teaching the cadets. The officer creates a situation in the lessons which keeps the students constantly interested in the problem at hand and develops their creative initiative.

In one of the lessons Major Kozlov noted that Cadet V. Sidorchuk was ignoring the problems of piloting technique in his analysis of an attack on an airborne target. This could lead to great unpleasantness in the air. The instructor advised him to turn his attention to aerodynamics and to making better use of the airplane's potentials. However, the recommendations did not produce any changes. The cadet began making mistakes in flight. Then Kozlov simulated several variants of situations that could evolve in the air and asked him to analyze them. During the discussion he asked questions which forced the student to think quickly and competently. This helped him correct his mistakes.

As with others, Major Kozlov comes across cases in which some cadets fall behind their peers for various reasons. In such cases the flight commander first determines how well the instructor is teaching the cadet, and if necessary he comes to his assistance. Using systems analysis in his search for effective ways to improve the skills of future pilots, he recreates the picture of their development in all of its details and interrelationships, placing the focus on the main factors responsible for the shortcomings in flight training. His broad erudition and competency make him successful.

The competency of an instructor: It presupposes mastery of the best methods, to include a concrete approach to selecting the most effective and sensible procedures, means and forms of personnel training and indoctrination, and the ability to utilize them integrally. There are other factors predetermining the competency of an instructor that are no less important: broadness of outlook, deep professional knowledge and a constant effort to improve teaching skills.

Practice shows, meanwhile, that some young instructors--recent school graduates--have a poor facility with the theory of teaching methods, and they do not know how to utilize the recommendations of military pedagogics and psychology or the experience of senior comrades. Recently I was witness to the following incident. Cadet M. Kurganskiy was having a hard time learning how to roll. The student could not get the angular rotation right. As a consequence the aircraft recovered at the low point of the maneuver at excessive speed. The advice and suggestions of the instructor only aggravated the situation.

The officer could do nothing to determine the causes behind the cadet's error. I therefore planned several sorties with Kurganskiy. I soon discovered that the young airman had a fear of overextending the control stick. Thus I had to show him how the airplane behaves when the control stick is overextended in horizontal maneuvers. Then we began practicing smooth recovery in the presence of insignificant, barely noticeable shaking, and in vertical maneuvers. In a word, we went from the simple to the complex. With time the cadet got a feeling for the airplane and began performing complex maneuvers confidently.

I think that my intervention need not have been required, had the instructor had any facility with training methods, and had he possessed deep knowledge of pedagogics and psychology.

The case I have just described once again persuaded me that unweakening attention must be devoted to improving the teaching skills of young instructors.

We unfailingly follow a certain principle of military pedagogics--the commander teaches his subordinates. We make extensive use of teacher training conferences and of independent study of special literature. All of this helps the instructors to fully master the existing methods of teaching flying to cadets, and to assimilate effective ways of shaping the necessary habits in them. Thus we make successful use of associative-reflex theory, which is based on conditioned reflex activity of the cerebral cortex. This means that assimilation of knowledge by a student is accompanied by formation of first highly simple and then complex associations in his consciousness. In other words a process of gradual active conceptualization occurs. For this purpose the instructor presents the material in classroom lessons comprehensibly and with an emotional charge, using vivid comparisons and visual aids.

The theory of step-by-step formation of actions, which is also used by the instructors, is associated to a greater extent with practical training. Learning begins with a trainer, and then it is continued in the aircraft cockpit. This helps cadets acquire the necessary habits of operating the aviation equipment. The teacher explains and shows what to do in particular circumstances. Gradually, under the unweakening attention of the instructor, the novice develops automatic habits in work with the aircraft controls. And it should be stated that the overwhelming majority of our instructors confidently employ the best teaching methods.

At the beginning of his flight training, Cadet V. Buben was having trouble with landing. He could not determine the moment at which to level out, and he had a hard time maintaining the glide path parameters. Instructor Captain A. Semashkin analyzed the causes of the failures and concluded that the cadet's habits were poorly developed and that his motor memory was weak. This made him lose confidence.

The officer organized his training into two stages. First he conducted lessons in which he drew diagrams and graphs thoroughly and comprehensibly explaining how the pilot should act in different phases of landing. He described his own impressions of the landing procedure. Then he sat down together with the cadet in the airplane and continued with his explanation of how to work with the cockpit equipment and what angle the cadet's line of sight should make with the ground. He tied in the second stage of the training more closely with practical problems. Under his guidance, Buben persistently practiced the elements of landing, and soon he caught up to his fellow students.

While still a young instructor I encountered difficulties which I could not surmount on my own. First-year cadets were placed in my group. I noted during the field training that P. Borishpol' was having a hard time assimilating the flight program, that he acted unconfidently in the air, and that he made many mistakes. No matter how I tried to help the cadet, I remained unsuccessful. Then I decided to try one more thing. Once during a flight when the cadet made an error I gave him a verbal slap on the wrist, hoping that this tactic would produce the desired result. But this did not do any good either. Borishpol' closed himself off even more. Contact with him was lost forever. The squadron commander helped me correct the mistake.

An individual approach to training and indoctrination, pedagogical tactfulness and a desire to establish soulful contact with a cadet are important components of an instructor's success. These are, of course, the abc's of pedagogics, but they still have to be recalled on occasion to the squadron instructor staff.

A few months ago Captain A. Semanshkin had to make a decision: Should he permit Cadet A. Vashchenko to go on with his training, even though he had fallen so far behind his comrades? He was phlegmatic in character, he did not distribute his attention properly in the air, he made the necessary decisions late, and he reacted too slowly to changes in the situation. In a word the cadet was hamstrung not only in his flight training but also in his psychological preparedness. Probably no one ever finds himself in an emergency situation without being influenced by it. The individual's behavior in such a case would vary. Some persons experience a deterioration in their performance as a result of stress, while others find on the contrary that the emotional excitement induces them to act. In any situation, even the most complex, a willful person is capable of perceiving and analyzing a large quantity of information and acting confidently and precisely.

How is a cadet to be taught to maintain control over himself? There are no ready-made recipes that suit all cases of life. But the main prerequisite of dependable psychological tempering of the future pilot is something that is known: purposeful and consistent indoctrination of high ideological conviction, discipline and a deep consciousness of one's military duty, and a persistent effort to teach proficient handling of the equipment.

Considering this, Captain Semashkin organized his work with his subordinate in such a way that psychological training would in a sense penetrate into all other forms of professional training. He asked Vashchenko's fellow classmates to help. On the instructor's recommendation they encouraged him to participate in various sports--soccer, volleyball and basketball, and they tried to create a situation which would help Vashchenko surmount his inertia and passiveness, and develop swifter reactions.

Soon the cadet began flying more confidently. Now the teacher has no doubt that Vashchenko will successfully master the flight training program.

It would be nice for us to have more instructors like Captain Semashkin, but well trained officers are often transferred from the school to other units. Their places are taken by lieutenants who have not accumulated sufficient experience and proficiency. This is natural. And yet practice shows that it is better to have experienced instructors break novices in. I feel, by the way, that the situation could be corrected by training young instructors in specialized courses or in special departments of flight schools. There can be no debate, after all, that an instructor must be not only a competent pilot but also a thoughtful teacher. This means that he must have had good teacher training, and he must possess professional experience. It is in an intimate combination of these two factors that we can find a guarantee of successful cadet training.

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